Colombia: Gas Capture, Compression, Utilization, and Social Responsibility

Krish "Ravi" Ravishankar
Director – Worldwide Environmental Affairs
Occidental Oil & Gas Corporation (OXY)
Houston, Texas, USA.

Agenda

GLOBAL FORUM
On Flaring and Venting Reduction and Natural Gas Utilisation

- Overview
  - Oxy's participation and accomplishments in Natural gas Star and Methane to Market programs
  - Oxy's Best Practices and Technologies on flaring and venting reduction and natural gas utilization in the U.S., Latin American, and Middle East Operations
- Colombia Case Studies
  - Gas Capture, Compression, and Power Generation, and Social Responsibility

Oxy's Natural Gas Star Program: Participation and Accomplishments

GLOBAL FORUM
On Flaring and Venting Reduction and Natural Gas Utilisation

History:

- OXY Signed in 2004
- 17 Bcf (41 million tonne CO_2e) methane reduction in the U.S.
  - Equivalent of removing 1.2 million passenger vehicles per year

- EPA Awards:
  - 2006: Implementation Manager of the Year
  - 2008 Production Partner of the Year

Methane-to-Markets Program

GLOBAL FORUM
On Flaring and Venting Reduction and Natural Gas Utilisation

History:

- OXY Signed in 2005
- Oxy Colombia sponsored the first international workshop in the region
- With EPA's assistance identified and working on three major projects in Colombia
  - Gas Capture/VRU Project at PF1, PF2, and Cari Care
- Working on projects in the Argentina
- EPA Award:
  - 2005: International Partner of the Year

Natural Gas Star International

GLOBAL FORUM
On Flaring and Venting Reduction and Natural Gas Utilisation

- Oxy signed as one of the Founding Charter Member: September 2006
- Oxy submitted the Implementation Plan for International Projects in 2008

Oxy's Experience: US and International Operations

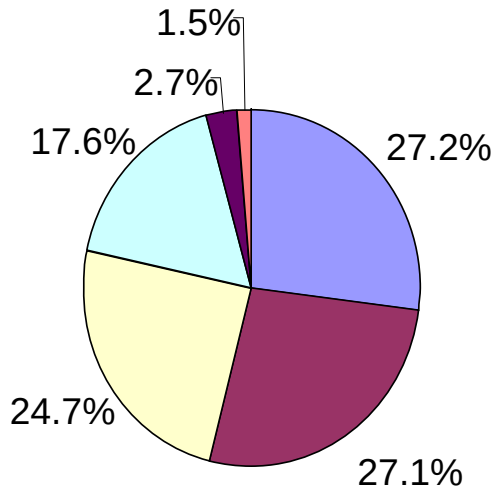
GLOBAL FORUM
On Flaring and Venting Reduction and Natural Gas Utilisation

TECHNOLOGIES	COUNTRIES APPLIED
Vapor Recovery Units (VRUs)	US, Qatar, Colombia, Argentina
Storage Tank Removal and Consolidation	US, Colombia, Argentina
Applying Protective Tank Coating	US, Oman, Argentina
Converting IC engines to electric	US, Argentina
Upgrading Compressor Packing	US
Connecting Process Safety Values (PSVs) to Flare	US, Oman, Qatar, Colombia
Fugitive Monitoring Programs	US
Installation of Non-Selective Catalytic Reduction (NSCR) control	US, Qatar, (Argentina, Colombia)

Oxy's Best Practices and Reduction Technologies

Oxy's Methane Emission Reduction in the US: 17 BCF:

To achieve these results, Oxy has employed these Natural Gas Star methane emission reduction technologies and best practices.



Install VRUs	27.2%
Fugitive Leak detection	27.1%
Reduced Emission Completions	24.7%
Install Electric Motors	17.6%
Convert to Instrument Air Systems	2.7%
Other	1.5%

Oxy International Methane Emission Reduction Proposed Projects for 2008 - 2010

GLOBAL FORUM
On Flaring and Venting Reduction and Natural Gas Utilisation

Country	Technology / Project Type
Argentina, Colombia, Oman	Install vapor recovery units on crude oil storage tanks
Colombia	Replace burst plates with secondary relief valves
Colombia	Replace flare and line due to mechanical integrity
Colombia	Fugitive emission inspection
Argentina	Connect production well casing to vapor recovery unit
Argentina	Eliminate unnecessary equipment and/or systems
Argentina, Colombia, Oman, Qatar	Reduce flaring of gas by installing compression
Argentina, Colombia	Use previously vented gas to run electric generators

Flare Reduction Projects

GLOBAL FORUM
On Flaring and Venting Reduction and Natural Gas Utilisation

- Oxy has completed several flare reduction projects in Oman and Qatar.
- These projects involve capturing previously flared gas and routing to a pipeline.
- In some instances, compression is added in order to reinject the gas into the formation or export for further treatment.

Colombia Case Study: Cano Limon

GLOBAL FORUM
On Flaring and Venting Reduction and Natural Gas Utilisation

Llanos Norte: 25 Years; >1 bbl oil production:

Oil Production: 97,171 BOPD

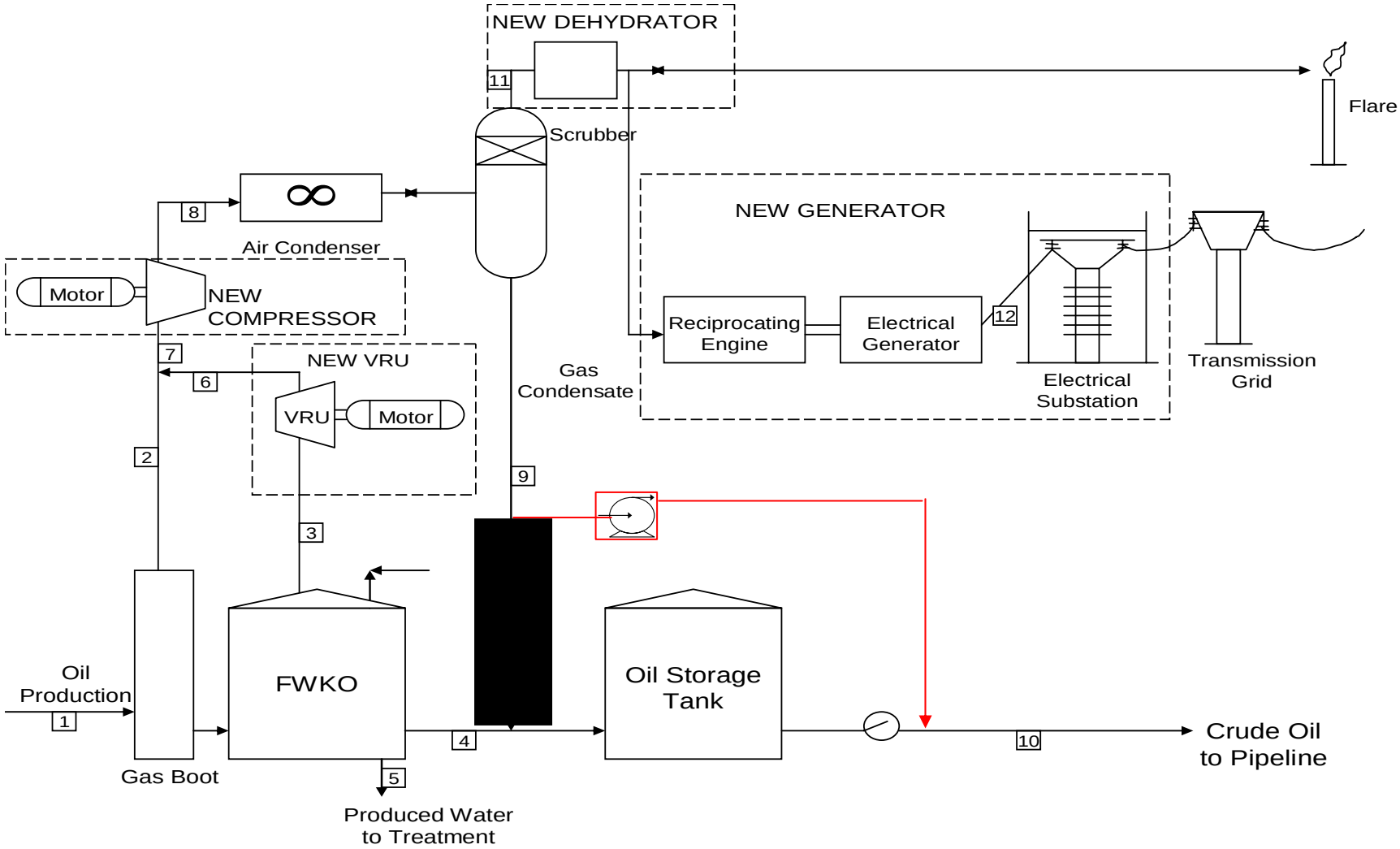
Produced Water: 2.5 Million BWPD

Number of Wells: 355

Production

facilities: PF1; PF2; Caricare

Process Flow Diagram



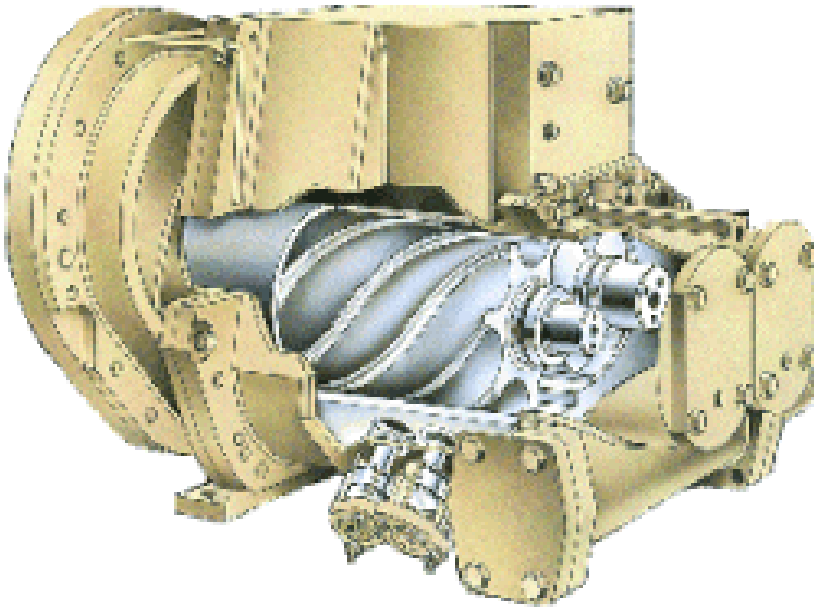
Gas characteristics to engines

GLOBAL FORUM
On Flaring and Venting Reduction and Natural Gas Utilisation

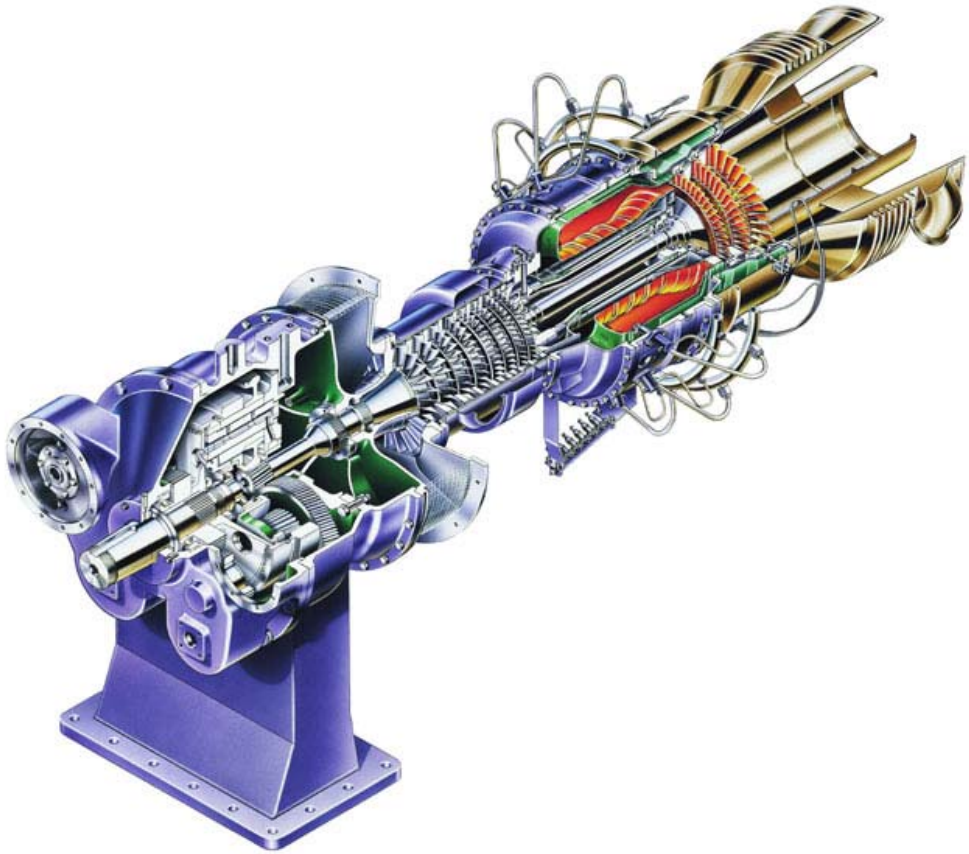
COMPONENTS	PF1 %	PF2 %
Methane	9.67	9.54
Ethane	1.5	0.65
Propane	5.66	2.94
i-Butane	5.76	3.61
n- Butane	8.99	5.49
Hydrocarbon	**31.47**	**22.23**
Inert gas	**67.93**	**77.27**

MMSCFD	**1.07**	**2.07**

Rotary Screw Compressors & Turbine Generator



Hy-Bon Screw Compressor



Solar Saturn Generator

Total Costs

GLOBAL FORUM
On Flaring and Venting Reduction and Natural Gas Utilisation

Annual	PF1	PF2	TOTAL
CAPEX (U$ million)	4.75 – 6.5	8.5 – 11.75	13.25 – 18.25
OPEX (U$ million)	0.03 – 0.05	0.03 – 0.05	0.06 – 0.10

CAPEX = Capital Expenditure
OPEX = Operation and Maintenance costs

La Cira Infantas (LCI) Project Area

GLOBAL FORUM
On Flaring and Venting Reduction and Natural Gas Utilisation

LCI: Social Environment

GLOBAL FORUM
On Flaring and Venting Reduction and Natural Gas Utilisation

- 11,000 inhabitants
- 2700 families
- 30 neighborhoods
- 17% illiteracy
- Tradition of Labor Strife
- Previous Guerrilla territory
- Current Paramilitary influence
- Political fragmentation power struggles
- 250 NGOs & Social Organizations
- Widespread poverty
- Unemployment 30%

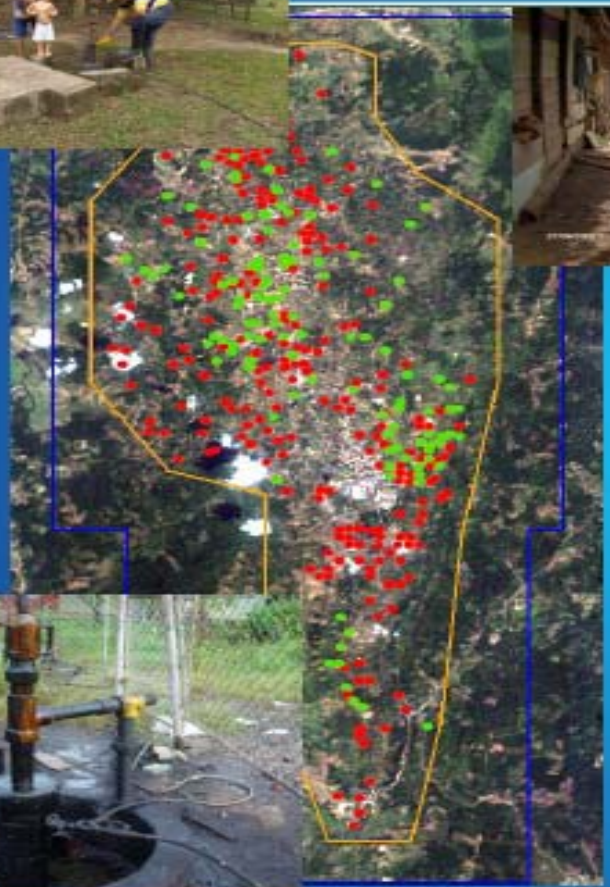
Working with Our Stakeholders

GLOBAL FORUM
On Flaring and Venting Reduction and Natural Gas Utilisation

Working with our Neighbors

GLOBAL FORUM
On Flaring and Venting Reduction and Natural Gas Utilisation

Residential Gas Supply



Items	Initial	Current
Total Wells	1700	1925
Well Connections	382	178
House Connections	1656	310

- Well connections
- Gas disconnected wells

LPG Supply Provided: 1,540 houses

Summary

GLOBAL FORUM
On Flaring and Venting Reduction and Natural Gas Utilisation

- Oxy experience with Gas Capture, Compression, Utilization, and Power Generation have been beneficial
- Pay Back on projects have ranged widely: 2 months to 8 years depending upon the type and magnitude of the projects
- We realized and recognized the need to implement solutions integrating social, economic, and environmental dimensions of project for substantiality
- EPA's technical assistance and resources have been highly valuable
- Technical barriers vary and include:
  - Lack of familiarity, benefits, and options of technologies
  - Lack of readily available measurement techniques and instruments (especially in some international locations)
  - Lack of outlet/stranded capacity for recovered gas
    - Spare compression capacity to boost gas to pipeline pressure
    - On-site fuel use
    - Gas processing plant in the vicinity to recover gas liquids
    - Perceived or short-term high capital costs of recovery technologies